

WHAT IS CLAIMED IS:

1. A method of detecting a motion vector between a plurality of frames of an image, the frames each including a plurality of blocks, the method comprising:

5 extracting a first block including a plurality of pixels from a first frame of the image;

detecting a second block from a plurality of blocks of a second frame of the image by block matching, the second block including the maximum number 10 of pixels each indicating an absolute difference value not more than a first threshold with respect to each of the pixels of the first block; and

computing a first motion vector between the first block and the second block.

15 2. The method according to claim 1, which further includes:

extracting a third block including a plurality of pixels from the second frame;

detecting a fourth block from a plurality of 20 blocks of the first frame by block matching, the fourth block including the maximum number of pixels each indicating an absolute difference value not more than a second threshold with respect to each of the pixels of the third block;

25 computing a second motion vector between the third block and the fourth block each of which includes the maximum number of pixels each indicating the absolute

difference value not more than the second threshold;

comparing the maximum number of pixels of the second block and the maximum number of pixels of the third block;

5 selecting the first motion vector when the maximum number of pixels of the second block is larger than the maximum number of pixels of the third block; and

10 selecting the second motion vector when the maximum number of pixels of the third block is larger than the maximum number of pixels of the second block.

3. The method according to claim 1, which further includes:

15 detecting a third block from a plurality of blocks of a third frame between the first frame and the second frame by block matching with respect to the first frame, the third block including the maximum number of pixels each indicating an absolute difference value not more than the first threshold with respect to each of the pixels of the first block;

20 computing a second motion vector between the third block and the first block;

 converting the second motion vector to a third motion vector toward the second frame from the third frame;

25 comparing the maximum number of pixels of the second block and the maximum number of pixels of the first block, each of the pixels of the first block and

second block indicating the absolute difference value not more than the first threshold;

selecting the first motion vector when the maximum number of pixels of the second block is larger than the maximum number of pixels of the first block; and

selecting the second motion vector when the maximum number of pixels of the first block is larger than the maximum number of pixels of the second block.

4. The method according to claim 3, wherein the third frame is an interpolation frame between the frames.

5. The method according to claim 4, which further includes dividing the first block into a first region and a second region; and wherein the detecting includes detecting a first region block from the second frame by block matching, and detecting a second region block from the second frame by block matching, and the computing includes computing a third motion vector between the first region and the first region block and a fourth motion vector between the second region and the second region block.

6. The method according to claim 5, which further includes extracting another first region block and another second region block from the second frame according to the third motion vector and the fourth motion vector, respectively, the another first region block corresponding to a locomotive point of a first

region interpolation block of the interpolation frame
that is on spatially the same location as the first
region of the first frame and the another second region
block corresponding to a locomotive point of a second
5 region interpolation block of the interpolation frame
that is on spatially the same location as the second
region, and assigning the another first region block
and the another second region block to the first region
interpolation block and the second region interpolation
10 block, respectively.

7. The method according to claim 3, wherein the
converting includes making $(k-n)/k$ times the second
motion vector, where the third frame is m -th frame, the
first frame is $(m+k)$ -th frame, and the second frame is
15 $(m+n)$ -th, and $|n| > |k|$.

8. A method of detecting a motion vector between
a plurality of frames of an image, the frames each
including a plurality of blocks, the method comprising:

20 extracting a plurality of first blocks each
including a plurality of pixels from a first frame of
the image;

detecting a plurality of second blocks each
including a plurality of pixels from a second frame of
the image;

25 computing a plurality of first motion vectors
between the first blocks and the second blocks;

counting the pixels of the second block each of

which indicates a first absolute difference value not more than a first threshold with respect to each of the pixels of the first block to obtain a first count value;

5 scaling one of the first motion vectors according to an interval between the second frame and a third frame between the first frame and the second frame to obtain a second motion vector;

10 extracting from the third frame a third block to which the first block moves, according to the second motion vector;

15 counting pixels of the third block each of which indicates an absolute difference value not more than a second threshold with respect to each of the pixels of the first block to obtain a second count value;

computing a weighted additional value represented by r . ($r = x \times p + (1-x) q; 0 < x < 1$) where p and q indicate the first count value and the second count value respectively; and

20 extracting from the first blocks and the second blocks a pair of blocks having the maximum weighted additional value; and

25 selecting a vector between the pair of blocks as a motion vector between the first frame and the second frame.

9. A method of detecting a motion vector between a plurality of frames of an image, the frames each

including a plurality of blocks, the method comprising:
extracting a plurality of first blocks each
including a plurality of pixels from a first frame;
detecting a second block from a plurality of
blocks of a second frame of the image by block
matching, the second block including the maximum number
of pixels each indicating an absolute difference value
not more than a first threshold with respect to each of
the pixels of one of the first blocks;
computing a first motion vector between the one of
the first blocks and the second block as a first region
motion vector between a first region of the one of the
blocks and the second frame;
extracting pixels in the first block that the
absolute difference value is not more than a second
threshold as a pixel block of the first region;
extracting pixels in the first block that the
absolute difference value is larger than the second
threshold as a pixel block of a second region;
extracting a third block from the second frame of
the image by block matching, the third block including
the maximum number of pixels each indicating an
absolute difference value not more than a third
threshold with respect to each of the pixels of the
pixel block of the second region; and
computing a second motion vector between the
second region and the third block.

10. The method according to claim 9, wherein
extracting the third block includes generating a first
spatial expansion region connecting spatially between
adjacent second regions in the first block, and
5 extracting the third block including the maximum number
of pixels each indicating the absolute difference value
not more than the third threshold with respect to each
of pixels of a pixel block of the first spatial
expansion region.

10 11. The method according to claim 9, which further
includes:

computing a third motion vector which is n times
the second motion vector;

15 extracting from a third frame a third block that
is a locomotive point of the pixel block of the second
region according to the third motion vector;

20 extracting a fourth block from a fourth frame
opposite to the second frame via the first frame by
block matching, the fourth block including the maximum
number of pixels each indicating an absolute difference
value not more than a fourth threshold with respect to
each of the pixels of the pixel block of the second
region; and

25 computing a fourth motion vector between the
second region and the fourth block;

computing a fifth motion vector which is n times
the fourth motion vector;

extracting from a fourth frame a fourth block that is a locomotive point of the pixel block of the second region according to the fourth motion vector; and

5 computing respective absolute difference values of the second block, the third block, the fourth block and the fifth block; and

10 selecting one of the second motion vector and the fourth motion vector as a motion vector of the second region according to the absolute difference values of the second block, the third block, the fourth block and the fifth block.

12. The method according to claim 9, which includes filtering the pixel block of the first region using a spatial region low pass filter.

15 13. A method of detecting a motion vector between a plurality of frames of an image, the frames each including a plurality of blocks, the method comprising:

extracting from a first frame a plurality of first blocks each having brightness information and color 20 difference information;

extract from a second frame a plurality of second blocks each having brightness information and color difference information;

25 computing a first absolute difference value between opposite pixels of a first brightness block having the brightness information of the first blocks and a second brightness block having the brightness

information of the second blocks;

computing a second absolute difference value between opposite pixels of a first color difference block and a second color difference block, the first

5 color difference block having the color difference information of the first blocks whose first absolute difference is not more than a first threshold and the second color difference block having the color difference information of the second blocks whose first absolute difference value is not more than the first threshold;

10 counting pixels that the second absolute difference value is not more than a second threshold to obtain a first count value;

15 extracting from the first blocks and the second blocks a pair of blocks each including pixels that the first count value is maximum;

computing a vector between the pair of blocks as a first region motion vector between a first region in

20 one of the first blocks and the second frame;

extracting pixels in the first block that the second absolute difference value is not more than the second threshold as a pixel block of the first region;

extracting pixels in the first block that the second absolute difference value is larger than the second threshold as a pixel block of the second region;

25 extracting from the second frame a third block

corresponding to the pixel block of the second region;
computing a third absolute difference value
regarding brightness of opposite pixels of the pixel
block of the second region and the third block;

5 counting pixels that the third absolute difference
value is not more than a third threshold to obtain a
second count value;

 extracting from the pixel block of the second
region and the third block a pair of blocks each
10 including pixels that the second count value is
maximum; and

 selecting a vector between the pair of blocks as
a second region motion vector between the second region
and the second frame.

15 14. A method of forming an interpolation image to
be interpolated in a third frame between a first frame
and a second frame, the method comprising:

 extracting from the first frame a first block
including a plurality of pixels;

20 detecting a second block from a plurality of
blocks of a second frame of the image by block
matching, the second block including the maximum number
of pixels each indicating an absolute difference value
not more than a first threshold with respect to each of
25 the pixels of the first block;

 computing a first motion vector between the first
block and the second block;

extracting pixels in the first block that the absolute difference value is not more than a second threshold as a pixel block of the first region;

5 extracting pixels in the first block that the absolute difference value is larger than the second threshold as a pixel block of the second region;

10 extracting a third block from the second frame of the image by block matching, the third block including the maximum number of pixels each indicating an absolute difference value not more than a third threshold with respect to each of the pixels of the pixel block of the second region;

computing a second motion vector between the second region and the third block;

15 scaling the first motion vector and the second motion vector according to a temporal position of the third frame;

20 extracting an interpolation block and a fifth block according to the scaled motion vector, the interpolation block being on the third frame that is at spatially the same position as the block on the first frame and the fifth block corresponding to a locomotive point of a region interpolation block on the third frame that is at spatially the same position as the pixel block; and

25 forming the interpolation image allocating the fifth block to the interpolation block of the third

frame and the region interpolation block.

15. The method according to claim 14, which further includes:

5 extracting a third block including a plurality of pixels from the second frame;

10 detecting a fourth block from a plurality of blocks of the first frame by block matching, the fourth block including the maximum number of pixels each indicating an absolute difference value not more than a second threshold with respect to each of the pixels of the third block;

15 computing a second motion vector between the third block and the fourth block,

15 comparing the maximum number of pixels of the second block and the maximum number of pixels of the third block;

20 selecting the first motion vector when the maximum number of pixels of the second block is larger than the maximum number of pixels of the third block; and

20 selecting the second motion vector when the maximum number of pixels of the third block is larger than the maximum number of pixels of the second block.

16. A method of displaying an image, comprising:

25 extracting from a first frame of an original image a first block including a plurality of pixels;

detecting a second block from a plurality of blocks of a second frame of the image by block

matching, the second block including the maximum number of pixels each indicating an absolute difference value not more than a first threshold with respect to each of the pixels of the first block;

5 computing a first motion vector between the first block and the second block;

 extracting pixels in the first block that the first absolute difference value is not more than the second threshold as a pixel block of the first region;

10 extracting pixels in the first block that the first absolute difference value is larger than the second threshold as a pixel block of the second region;

 extracting a third block from the second frame of the image by block matching, the third block including the maximum number of pixels each indicating an absolute difference value not more than a third threshold with respect to each of the pixels of the pixel block of the second region;

15 computing a second motion vector between the second region and the third block;

 scaling the first motion vector and the second motion vector according to a temporal position of the third frame;

25 extracting an interpolation block and a fifth block according to the scaled motion vector, the interpolation block being on the third frame that is at spatially the same position as the block on the first

frame and the fifth block corresponding to a locomotive point of a region interpolation block on the third frame that is at spatially the same position as the pixel block;

5 forming the interpolation image allocating the fifth block to the interpolation block of the third frame and the region interpolation block; and displaying the original image and the interpolation image.

10 17. An interpolation picture generation apparatus which generates an interpolation picture to be interpolated in a third frame between a first frame and a second frame, the apparatus comprising:

15 a frame extraction unit configured to extract from the first frame a first block including a plurality of pixels;

20 a detection unit configured to detect a second block from a plurality of blocks of the second frame by block matching, the second block including the maximum number of pixels each indicating an absolute difference value not more than a first threshold with respect to each of the pixels of the first block;

25 a computation unit configured to compute a first motion vector between the first block and the second block;

a pixel extraction unit configured to extract pixels in the first block that the first absolute

difference value is not more than the second threshold as a pixel block of the first region;

5 a pixel extraction unit configured to extract pixels in the first block that the first absolute difference value is larger than the second threshold as a pixel block of the second region;

10 a block extraction unit configured to extract a third block from the second frame by block matching, the third block including the maximum number of pixels each indicating an absolute difference value not more than a third threshold with respect to each of the pixels of the pixel block of the second region;

15 a computation unit configured to compute a second motion vector between the second region and the third block;

a scaling unit configured to scale the first motion vector and the second motion vector according to a temporal position of the third frame;

20 a block extraction unit configured to extract an interpolation block and a fifth block according to the scaled motion vector, the interpolation block being on the third frame that is at spatially the same position as the block on the first frame and the fifth block corresponding to a locomotive point of a region
25 interpolation block on the third frame that is at spatially the same position as the pixel block; and

an interpolation forming unit configured to form

the interpolation picture allocating the fifth block to the interpolation block of the third frame and the region interpolation block.

18. The apparatus according to claim 16, which
5 further includes:

a block extraction unit configured to extract a third block including a plurality of pixels from the second frame;

10 a detection unit configured to detect a fourth block from a plurality of blocks of the first frame by block matching, the fourth block including the maximum number of pixels each indicating an absolute difference value not more than a second threshold with respect to each of the pixels of the third block;

15 a computation unit configured to compute a second motion vector between the third block and the fourth block,

20 a comparison unit configured to compare the maximum number of pixels of the second block and the maximum number of pixels of the third block;

a selection unit configured to select the first motion vector when the maximum number of pixels of the second block is larger than the maximum number of pixels of the third block; and

25 a selection unit configured to select the second motion vector when the maximum number of pixels of the third block is larger than the maximum number of pixels

of the second block.

19. A display apparatus, comprising:

an extraction unit configured to extract from
a first frame of an original picture a first block
5 including a plurality of pixels;

a detection unit configured to detect a second
block from a plurality of blocks of a second frame of
the picture by block matching, the second block
including the maximum number of pixels each indicating
10 an absolute difference value not more than a first
threshold with respect to each of the pixels of the
first block;

a computation unit configured to compute a first
motion vector between the first block and the second
15 block;

an extraction unit configured to extract pixels in
the first block that the first absolute difference
value is not more than the second threshold as a pixel
block of the first region;

20 an extraction unit configured to extract pixels in
the first block that the first absolute difference
value is larger than the second threshold as a pixel
block of the second region;

25 an extraction unit configured to extract a third
block from the second frame by block matching, the
third block including the maximum number of pixels each
indicating an absolute difference value not more than

a third threshold with respect to each of the pixels of the pixel block of the second region;

5 a computation unit configured to compute a second motion vector between the second region and the third block;

a scaling unit configured to scale the first motion vector and the second motion vector according to a temporal position of the third frame;

10 an extraction unit configured to extract an interpolation block and a fifth block according to the scaled motion vector, the interpolation block being on the third frame that is at spatially the same position as the block on the first frame and the fifth block corresponding to a locomotive point of a region
15 interpolation block on the third frame that is at spatially the same position as the pixel block;

20 an interpolation picture forming unit configured to form an interpolation picture allocating the fifth block to the interpolation block of the third frame and the region interpolation block; and

a display which displays the original picture and the interpolation picture.